

MILITARY SPECIFICATION

SEMICONDUCTOR DEVICE, TRANSISTOR, PNP, GERMANIUM, HIGH-POWER

TYPE 2N1358

This specification is mandatory for use by all Departments and Agencies of the Department of Defense.

1. SCOPE

1.1 Scope. This specification covers the detail requirements for a high-power, PNP, germanium transistor.

1.2 Physical dimensions. See figure 1 (TO-36).

1.3 Maximum ratings.

P_C ^{1/} $T_{MB} = 25^\circ C$	I_E	I_B	V_{CBO}	V_{EBO}	V_{CEO}	T_{stg}
<u>W</u>	<u>Adc</u>	<u>Adc</u>	<u>Vdc</u>	<u>Vdc</u>	<u>Vdc</u>	<u>°C</u>
150	15	4	-80	-40	-40	-65 to +100

^{1/} Derate 2.0 W/°C for $T_{MB} > 25^\circ C$.

1.4 Primary electrical characteristics.

	h_{FE} at $V_{CE} = -2 Vdc$		$V_{CE(sat)}$	f_{hfe}	θ_{J-C}
	$I_C = -1.2 Adc$	$I_C = -5 Adc$	$I_C = -12 Adc$ $I_B = -2 Adc$		
			<u>Vdc</u>	<u>kHz</u>	<u>°C/W</u>
Min	40	25	---	5	---
Max	100	50	-0.7	---	0.5

2. APPLICABLE DOCUMENTS

2.1 The following documents, of the issue in effect on date of invitation for bids or request for proposal, form a part of the specification to the extent specified herein.

SPECIFICATION

MILITARY

MIL-S-19500 - Semiconductor Devices, General Specification for.

STANDARDS

MILITARY

- MIL-STD-202 - Test Methods for Electronic and Electrical Component Parts.
- MIL-STD-750 - Test Methods for Semiconductor Devices.

(Copies of specifications, standards, drawings, and publications required by suppliers in connection with specific procurement functions should be obtained from the procuring activity or as directed by the contracting officer.)

2.2 Other publications. The following document forms a part of this specification to the extent specified herein. Unless otherwise indicated, the issue in effect on date of invitation for bids or request for proposal shall apply.

NATIONAL BUREAU OF STANDARDS

- Handbook H28 - Screw-Thread Standards for Federal Services.

(Application for copies should be addressed to the Superintendent of Documents, Government Printing Office, Washington, D.C. 20402.)

3. REQUIREMENTS

3.1 General. Requirements shall be in accordance with MIL-S-19500, and as specified herein.

3.2 Abbreviations, symbols, and definitions. The abbreviations, symbols, and definitions used herein are defined in MIL-S-19500, and as follows:

T_{MB} Temperature of the mounting surface of the device.

3.3 Design, construction, and physical dimensions. Transistor shall be of the design, construction, and physical dimensions shown on figure 1.

3.4 Performance characteristics. Performance characteristics shall be as specified in tables I, II, and III.

3.5 Marking. The following marking specified in MIL-S-19500 may be omitted from the body of the transistor at the option of the manufacturer:

- (a) Country of origin.
- (b) Manufacturer's identification.

4. QUALITY ASSURANCE PROVISIONS

4.1 Sampling and inspection. Sampling and inspection shall be in accordance with MIL-S-19500, and as specified herein.

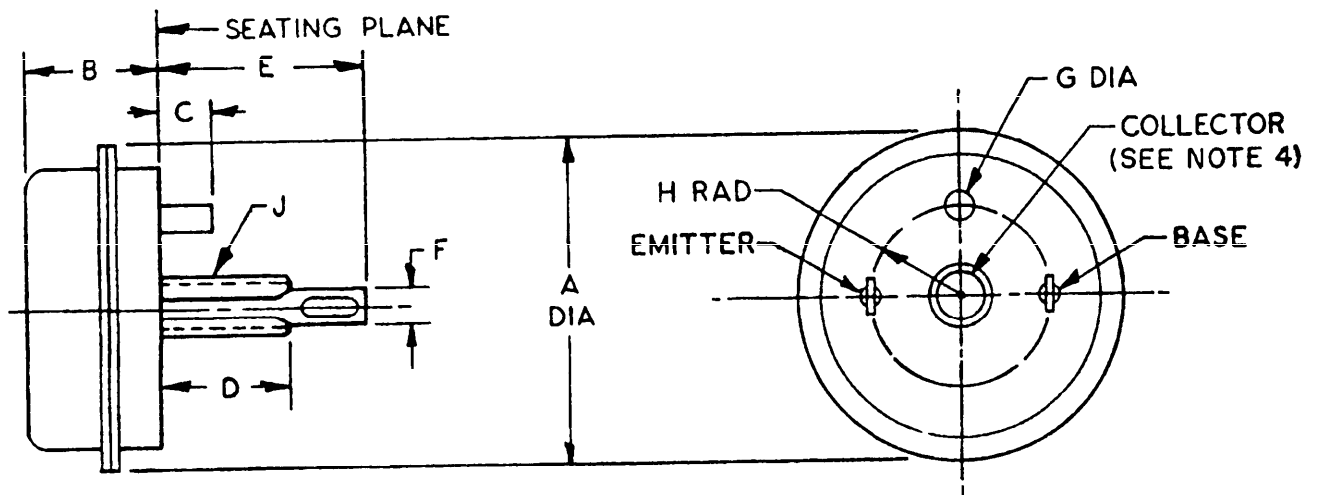
4.2 Qualification inspection. Qualification inspection shall consist of the examinations and tests specified in tables I, II, and III.

4.3 Quality conformance inspection. Quality conformance inspection shall consist of groups A, B, and C inspections.

4.3.1 Group A inspection. Group A inspection shall consist of the examinations and tests specified in table I.

4.3.2 Group B inspection. Group B inspection shall consist of the examinations and tests specified in table II.

4.3.3 Group C inspection. Group C inspection shall consist of the examinations and tests specified in table III. This inspection shall be conducted on the initial lot and thereafter every 6 months during production.



DIMENSIONS					NOTES
LTR	INCHES		MILLIMETERS		
	MIN	MAX	MIN	MAX	
A	---	1.250	---	31.75	
B	---	.520	---	13.21	
C	.125	.312	3.18	7.92	
D	.375	.500	9.53	12.70	
E	.610	.710	15.49	18.03	3
F	---	.190	---	4.83	3
G	---	.140	---	3.56	5
H	.335	.355	8.51	9.02	
J	---	---	---	---	2

NOTES:

1. Metric equivalents (to the nearest .01 mm) are given for general information only and are based upon 1 inch = 25.4 mm.
2. 10-32 UNF-2A, according to Handbook H28.
3. Two leads.
4. The collector shall be internally connected to the mounting base.
5. Cylindrical surface of the locating pin shall be insulated so that electrical contact is not made with the heat sink. Dimension G shall include this insulation. Figure 2 preferred measurement method.

FIGURE 1. Physical dimensions of transistor type 2N1358 (TO-36).

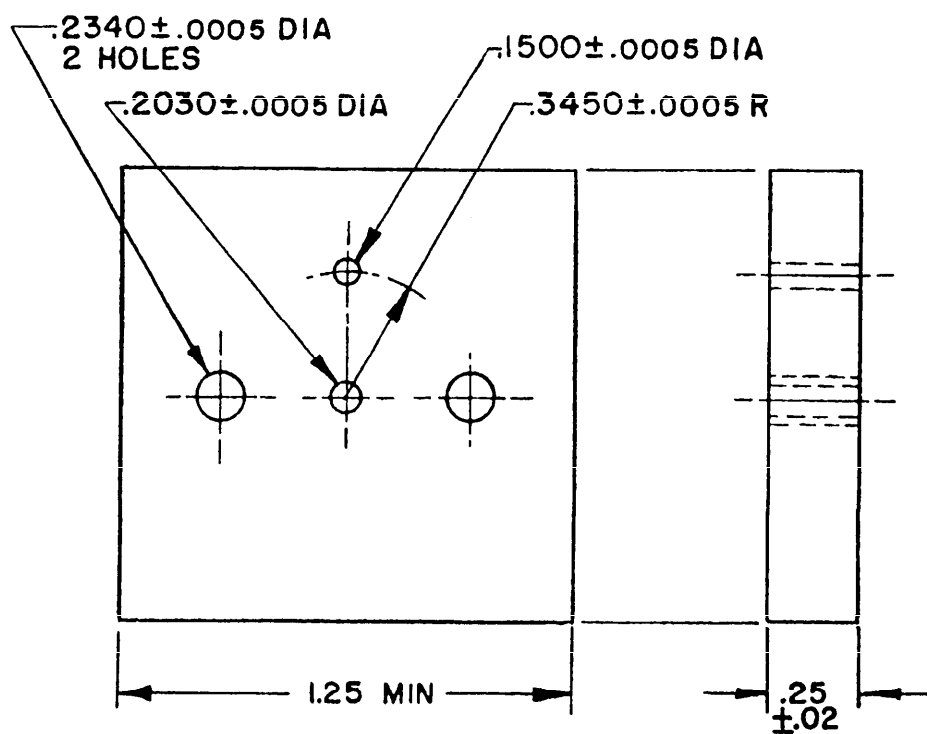


FIGURE 2. Alinement gage for transistor type 2N1358.

* 4.3.4 Group B and group C life-test samples. Samples that have been subjected to group B, 340-hours life-test, may be continued on test for 1,000-hours in order to satisfy group C life-test requirements. These samples shall be predesignated, and shall remain subjected to the group C 1,000-hour acceptance evaluation after they have passed the group B, 340-hour acceptance criteria. The cumulative total of failures found during 340-hour test and during the subsequent interval up to 1,000 hours shall be computed for 1,000-hour acceptance criteria.

4.4 Methods of examination and test. Methods of examination and test shall be as specified in tables I, II, and III, and as follows:

4.4.1 Inspection conditions. All measurement shall be made at $T_{MB} = 25^{\circ}C$ unless otherwise specified.

* 4.4.2 Terminal strength (stud torque). Acceptance criteria after the stud torque test shall be 10-32 UNF-2A for external threaded parts in accordance with Handbook H28.

TABLE I. Group A inspection

Examination or test	MIL-STD-750		L T P D	Symbol	Limits		
	Method	Details			Min	Max	Unit
<u>Subgroup 1</u>			10				
Visual and mechanical examination	2071			---	---	---	---
<u>Subgroup 2</u>			5				
Breakdown voltage, collector to emitter	3011	Bias cond. D; $I_C = -300\text{ mAdc}$		BV_{CEO}	-40	---	Vdc
Breakdown voltage, collector to emitter	3011	Bias cond. C; $I_C = -300\text{ mAdc}$		BV_{CES}	-70	---	Vdc
Collector to base cutoff current	3036	Bias cond. D; $V_{CB} = -2\text{ Vdc}$		I_{CBO}	---	-200	μAdc
Collector to base cutoff current	3036	Bias cond. D; $V_{CB} = -80\text{ Vdc}$		I_{CBO}	---	-4	mAdc
Emitter to base cutoff current	3061	Bias cond. D; $V_{EB} = -40\text{ Vdc}$		I_{EBO}	---	-4	mAdc
* <u>Subgroup 3</u>			5				
Forward-current transfer ratio	3076	$V_{CE} = -2\text{ Vdc}; I_C = -1.2\text{ Adc}; t_p = 1\text{ sec max}$		h_{FE}	40	100	---
Forward-current transfer ratio	3076	$V_{CE} = -2\text{ Vdc}; I_C = -5\text{ Adc}; t_p = 1\text{ sec}; \text{max, duty cycle} = 1\text{ to }2\%$		h_{FE}	25	50	---
Collector to emitter voltage (saturated)	3071	$I_C = -12\text{ Adc}; I_B = -2\text{ Adc}$		$V_{CE(sat)}$	---	-0.7	Vdc
Base emitter voltage (nonsaturated)	3066	Test cond. B; $V_{CE} = -2\text{ Vdc}; I_C = -1.2\text{ Adc}$		V_{EB}	---	0.5	Vdc
Base emitter voltage (nonsaturated)	3066	Test cond. B; $V_{CE} = -2\text{ Vdc}; I_C = -5\text{ Adc}$		V_{EB}	---	0.9	Vdc

TABLE I. Group A inspection - Continued

Examination or test	MIL-STD-750		L T P D	Symbol	Limits		
	Method	Details			Min	Max	Unit
* <u>Subgroup 4</u>			10				
Small-signal short-circuit forward-current transfer-ratio cutoff frequency	3301	$V_{CE} = -6 \text{ Vdc}$; $I_C = -5 \text{ Adc}$		f_{hfe}	5	---	kHz
High-temperature operation	---	$T_C = +71^\circ \text{C min}$		---	---	---	---
Collector to base cutoff current	3036	Bias cond. D; $V_{CB} = -30 \text{ Vdc}$		I_{CBO}	---	-6	mAdc

TABLE II. Group B inspection

Examination or test	MIL-STD-750		L T P D	Symbol	Limits		
	Method	Details			Min	Max	Unit
<u>Subgroup 1</u>			20				
Physical dimensions	2066	(See figure 1)		---	---	---	---
<u>Subgroup 2</u>			15				
Solderability	2026	Omit aging		---	---	---	---
Thermal shock (temperature cycling)	1051	Test cond. B, except step 3; $t_{\max} = +95 + 5^\circ \text{C}$ -0		---	---	---	---
Thermal shock (glass strain)	1056	Test cond. B		---	---	---	---
Terminal strength (tension)	2036	Test cond. A; weight = 10 lbs; $t = 15 \text{ sec}$ to each terminal		---	---	---	---
Terminal strength (terminal torque)	2036	Test cond. D1; torque = 24 in.-oz. to be applied to flat of each terminal for $t = 15 \text{ sec}$		---	---	---	---
Terminal strength (stud torque)	2036	Test cond. D2; torque = 12 in.-lbs.; $t = 15 \text{ sec}$ (see 4.4.2)		---	---	---	---
Seal (leak-rate)	---	Method 112 of MIL-STD-202, test cond. C, procedure III; test cond. B for gross leaks		---	---	5×10^{-7}	atm cc/sec
Moisture resistance	1021	Omit initial conditioning		---	---	---	---
End points: Collector to base cutoff current	3036	Bias cond. D; $V_{CB} = -80 \text{ Vdc}$		I_{CBO}	---	-4	mAdc
Forward-current transfer ratio	3076	$V_{CE} = -2 \text{ Vdc}$; $I_C = -5 \text{ Adc}$; $t_p = 1 \text{ sec max}$; duty cycle = 1 to 2%		h_{FE}	25	50	---

TABLE II. Group B inspection - Continued

Examination or test	MIL-STD-750		L T P D	Symbol	Limits		
	Method	Details			Min	Max	Unit
<u>Subgroup 3</u>			15				
Shock	2016	Nonoperating; 1500 G, approx. 0.5 msec; 5 blows in each orientation: X_1 , Y_1 , Y_2 , and Z_1		---	---	---	---
Vibration fatigue	2046	Nonoperating		---	---	---	---
Vibration, variable frequency	2056			---	---	---	---
Constant acceleration	2006	Nonoperating; 2000 G in each orientation: X_1 , Y_1 , Y_2 , and Z_1		---	---	---	---
End points: (Same as subgroup 2)							
<u>Subgroup 4</u>			20				
Salt atmosphere (corrosion)	1041			---	---	---	---
End points: (Same as subgroup 2)							
<u>Subgroup 5</u>			7				
High-temperature life (nonoperating)	1031	$T_{stg} = +100^\circ\text{C}$; time = 340 hours		---	---	---	---
End points: Collector to base cutoff current	3036	Bias cond. D; $V_{CB} = -80\text{ Vdc}$		I_{CBO}	---	-8	mAdc
Forward-current transfer ratio	3076	$V_{CE} = -2\text{ Vdc}$; $I_C = -5\text{ Adc}$; $t_p = 1\text{ sec max}$, duty cycle = 1 to 2%		h_{FE}	20	60	---
<u>Subgroup 6</u>			10				
Steady state operation life	1026	$V_{CB} = -15\text{ Vdc}$; $P_C = 20\text{ W}$; $T_{MB} = +90^\circ\text{C}$; time = 340 hours		---	---	---	---
End points: (Same as subgroup 5)							

TABLE III. Group C inspection

Examination or test	MIL-STD-750		L T P D	Symbol	Limits		
	Method	Details			Min	Max	Unit
<u>Subgroup 1</u>			20				
Barometric pressure, reduced (altitude operation)	1001	Normal mounting; Pressure = 8 mm. Hg. for 60 sec min.		---	---	---	---

TABLE III. Group C inspection - Continued

Examination or test	MIL-STD-750		L T P D	Symbol	Limits		
	Method	Details			Min	Max	Unit
<u>Subgroup 1 - Continued</u>							
Measurement during test:							
Collector to base cutoff current	3036	Bias cond. D; $V_{CB} = -80$ Vdc	20	I_{CBO}	---	-4	mAdc
Thermal resistance	3151			θ_{J-C}	---	0.5	°C/W
Floating potential	3020	$V_{CB} = -80$ Vdc; voltmeter input resistance ≥ 10 meg		V_{EBF}	---	-0.5	Vdc
<u>Subgroup 2</u>							
Burnout by pulsing	3005	$I_B = -4$ Adc; $I_E = 15$ Adc; $t_p = 60$ sec min 1 cycle	$\lambda = 10$	---	---	---	---
End points: Forward-current transfer ratio	3076	$V_{CE} = -2$ Vdc; $I_C = -5$ Adc; $t_p = 1$ sec max, duty cycle = 1 to 2%		h_{FE}	25	50	---
<u>Subgroup 3</u>							
High-temperature life (nonoperating)	1031	$T_{stg} = +100^\circ\text{C}$	$\lambda = 15$	---	---	---	---
End points: (Same as subgroup 5 of group B)							
<u>Subgroup 4</u>							
Steady state operation life	1026	$V_{CB} = -15$ Vdc; $P_C = 20$ W; $T_{MB} = +90^\circ\text{C}$		---	---	---	---
End points: (Same as subgroup 5 of group B)							

5. PREPARATION FOR DELIVERY

5.1 See MIL-S-19500, section 5.

6. NOTES

6.1 Notes. The notes specified in MIL-S-19500 are applicable to this specification.

6.2 Changes from previous issue. The outside margins of this document have been marked "*" to indicate where changes (deletions, additions, etc.) from the previous issue have been made. This has been done as a convenience only and the Government assumes no liability whatsoever for any inaccuracies in these notations. Bidders and contractors are cautioned to evaluate the requirements of this document based on the entire content as written irrespective of the marginal notations and relationship to the last previous issue.

Custodians:

Army - EL
Navy - SH
Air Force - 11

Preparing activity:

Army - EL

(Project 5961-0009-13)

Review activities:

Army - EL, MU, MI
Navy - SH
Air Force - 11, 17, 85

Code "C"

User activities:

Army - EL, SM
Navy - AS, OS, CG, MC
Air Force - 14, 19